MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

OPEN BOOK TEST 1

TRIMESTER 3, 2020/2021

EEL2216 – CONTROL THEORY

(All sections / Groups)

24 MAY 2021
11:00AM – 12:30PM
(1.5 hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 2 questions only.

2. Attempt **ALL** questions. The distribution of marks for each question is given.

Question 1

(a) Find the initial value of $\frac{d}{dt}g(t)$ if the Laplace transform of $g(t)$ is given by

$$G(s) = L[g(t)] = \frac{\alpha s + 3}{(s+1)(s+2)}.$$

Note that α is the third digit of your student ID. For example, α = 5 for student ID 1453678920. [4 marks]

(b) A certain system has an overall transfer function given by $H(s) = \frac{\beta}{s+\beta}$, where β is the last non-zero digit of your student ID. For example β = 2 for student ID 1453678920. Assuming zero initial conditions, find the expression of output $y(t)$ given the input $x(t) = 2t$, $t \geq 0$. [8 marks]

(c) A control system can be represented by the two-path signal-flow graph shown in Figure Q1, where $R(s)$ is the input while $Y(s)$ is the output. Obtain the transfer function, $\frac{Y(s)}{R(s)}$ of the system using Mason's rule. [13 marks]

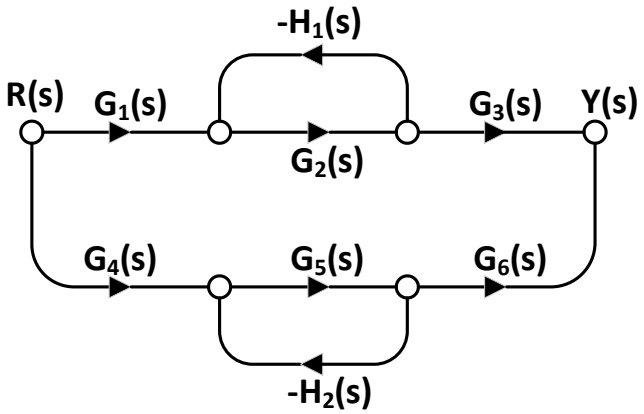

Figure Q1

Continued …

Question 2

(a) A feedback control system is as shown in Figure Q2. It is given that $G(s) = \frac{s+(a+1)}{s^2+bs}$, where $ab =$ last 2 digits of your MMU student ID number (e.g., if the last two digits of your student ID is 12, then $a = 1, b = 2$).

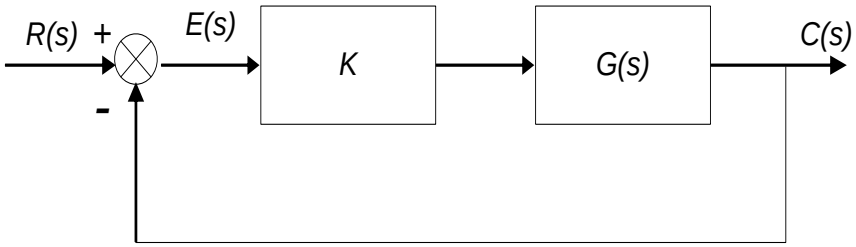

Figure Q2

(i) Obtain the closed-loop transfer function of the system in Figure Q2. [3 marks]

(ii) Based on the characteristic equation of the system, determine the suitable range of *K* for the system to be stable. [4 marks]

(iii) If $K = ab + 50$, would the system still be stable? Hence, evaluate the steady-state error, e_{ss} for a unit-ramp input. [5 marks]

(b) A unity feedback system has the following loop transfer function, where α is the third digit of your student ID. For example $\alpha = 5$ for student ID 1453678920.

$$KG(s)H(s) = \frac{10Ks(s+\alpha)}{(s+1)(s^2+2s+2)}$$

Based on the break-in point for the respective α as shown in Table Q2, plot the root locus of the system. Comment on the system stability as *K* is varied from 0 to ∞. [13 marks]

Table Q2

α	2	3	4	5	6	7	8	9
Break-in point (on real axis)	-3.1	-4.8	-6.8	-8.7	-10.7	-12.6	-14.6	-15.9

End of Paper